

PLANETARY TRANSMISSION

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The invention concerns a planetary transmission according to the generic portion of patent claim 1.

A similar transmission with a two-stage design is known from EP 0 824 640 B1.

The invention concerns itself with the problem of being able to achieve a significantly greater transmission ratio and torque transfer in this type of transmission without significantly enlarging the overall volume. In addition, the stiffness of the transmission is to be elevated significantly. Furthermore, the transmission is to be economically producible with simple means and is to ensure low-wear operation and transmission with little play.

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This problem is solved through the embodiment of a transmission of this type according to the characterizing features of patent claim 1.

Advisable embodiments are the object of the sub-claims.

By using four planet wheels across the width in individual transmission stages, on one hand, high torques can be transmitted in these transmission stages, and, on the other hand, the stiffness of the transmission is significantly elevated.

Unexpectedly favorable transmission ratios resulted when the transmission stages were each designed with four planet wheels in a planet carrier having a transmission ratio of $i = 5.5$, particularly when the internal gear had 108 teeth. Total transmission ratios which were even could be achieved, particularly if an odd transmission ratio $i = 5.5$ was used.

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In a planetary transmission implemented in three stages according to the invention, the overall transmission ratio can be calculated according to the formula

$$i_{ov} = i_1 \times i_2 \times i_3 - (i_1 \times i_2 - 1)$$

According to this, a maximum practically achievable transmission ratio is $i = 901$.

An exemplary embodiment subsequently described in more detail is shown in the drawing.

Fig. 1 shows a schematic view of a three-stage planetary transmission,

Fig. 2 shows a planetary transmission implemented in an alternative way to the implementation shown in Fig. 1.

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DESCRIPTION OF THE EMBODIMENT SHOWN IN FIG. 1

The rotatable parts of a three-stage planetary transmission are mounted inside a transmission housing 1. In the exemplary embodiment shown, the transmission gears down from left to right.

The three transmission stages are labeled with I, II, and III.

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In the first transmission stage I, a first sun wheel 2, which can be driven from outside, engages in first planet wheels 3, which are mounted in a first planet carrier 4. Three first planet wheels 3 are mounted in the first planet carrier 4, distributed across its width.

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The first planet wheels 3 mesh in an internal gear 6, which is rigidly connected with the planet carrier of the third

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The two first transmission stages I, II act functionally as if they are connected in series.

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In a transmission according to the invention which has the approximately the same volume as that known from EP 0 824

640 B1, but is slightly larger, an increase of more than 50 % in the torque to be transmitted can be achieved. In the same way, an increase of approximately 50 % in stiffness is also possible. These increases result, besides from the additional transmission stage, particularly from a use of four planet wheels in each of the two driven stages II, III, and from the selection of a transmission ratio of $i = 5.5$ in the transmission stages II, III, each of which are equipped with four planet wheels.

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C67 Naturally, the first transmission stage I can also be implemented with four planet wheels distributed across its width.

As in the known transmission according to EP 0 824 640 B1, the driven planet carrier is also in this case to be mounted on roller bearings inside the transmission housing 1 on both sides of the planet wheels it carries, and is to be axially fixed.

The individual planet wheels are mounted in the planet carriers with as little friction as possible in a way typical per se.

For transmission of higher moments, a three-stage transmission according to the invention can be advantageously designed as follows.

- All internal gears have a number of teeth $z = 108$.

Sub
C77 In the third transmission stage, four planet wheels are provided in the planet carrier distributed across its width and $i_3 = 5.5$ is set as the transmission ratio.

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CG distributed over its width and $i_2 = 4$ or $i_2 = 5.5$ is set as the transmission ratio for this stage.

Sub In the first transmission stage, three planet wheels are provided in the planet carrier distributed over its width and $i_1 = 3, 4, 5, 7, 10$ can be set as the transmission ratio for this stage.

Sub For an internal gear with $z = 108$ teeth, surprisingly, with a predetermined transmission ratio of $i = 5.5$, four planet wheels can be used in an associated planet carrier, distributed across its width. In spite of this odd single stage transmission ratio, an even overall transmission can be achieved through kinematics according to the invention.

A particular advantage is that, through the transmission kinematics according to the invention and possible individual or overall transmission ratios, in a three-stage transmission, for example, uniform reliability of the gearings can be achieved, which allows, in turn, high transmittable moments with, at the same time, low wear.

Only a slight, extremely damped noise emission issues outside the transmission housing from the rapidly running and therefore noise-intensive first two transmission stages. This is because the rotating parts of the first two transmission stages are not connected directly with the fixed transmission, and therefore, structure-borne noise issuing from them is only relayed over long paths with parting lines, which practically corresponds to a noise enclosure.

With a number of teeth $z = 108$ for the internal gears and transmission ratios of a maximum of $i = 10$ each in all three transmission stages, as well as three planet wheels distributed across the width in each transmission stage, a

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DESCRIPTION OF THE EMBODIMENT SHOWN IN FIG. 2

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